

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Referring now to FIG. 1 and 2 of the drawings, shows a fragmentary cross section view of a portion of the embodiments of this novel reflective pavement marking sheet, said fragment is designated as marker 10 which comprises multiple raised reflective portions 12 each followed by a planar reflective flat ~~{sheet}~~ portion 18. A typical reflective marking sheet ~~[may contain hundreds of]~~ contain multiple raised reflective portions 12 intermittently connected with planar reflective ~~[sheet]~~ portion 18. The length of such reflective sheet having multiple reflective portions 12 can be substantially continuous to any desired length that would be applicable for roadway usage.

Each raised reflective portions 12 have an exterior comprising of a top surface 16, two inclined reflective faces 14 on opposite directions, two inclined or arcuate sides 29.

When the desired reflective portions 12 is having significantly higher profile of about 0.2 to 0.5 inch ~~[an]~~ arcuate sides 29 can be formed intermittently, as shown in FIG. 8, and at any desired intervals within a giving width of said reflective pavement marking sheet 10. [,] ~~[otherwise]~~ For reflective portions 12 with lesser heights, the sides 29 can have ~~[a]~~ simple inclined surfaces.

Each of the inclined reflective faces 14 has an inside surface with multiple of integrally formed micro cube corner reflective elements 20 defined by multi directional load carrying partition walls 22. Inclined reflective face 14 form an internal angle of about 25 to 35 degrees with respect to the base surface.

~~[For wider]~~ A preferred high profiled reflective portion 12, ~~[the]~~ can have partition walls 22 ~~[may be]~~ sub divided into multiple walls, as shown in FIG. 7.

FIG. 8 ~~[is]~~ shows a typical elevation view of a high profiled reflective portion 12.

Hollow cavities 24 are integrally formed separating the apexes of the cube corner reflective elements 20 within inside of each inclined reflective face 14 ~~[and]~~. The multi directional load carrying partition walls 22 ~~[that define]~~ provide structural support for the reflective portions 12. ~~[each of said face]~~

The reflective flat ~~[sheets]~~ portions 18, which integrally connect each two raised reflective portions 12, have ~~[an]~~ exterior planar surfaces that may incorporate slightly raised bumpers 27 and a lower base surface integrally formed with multiple cube corner reflective elements 20. ~~[either]~~ Reflective elements 20 can be formed within cell like areas defined by slightly raised ridges 28 or it can be without any boundaries or ridges 28.

Bumpers 27 can be eliminated when the reflective flat ~~[sheets]~~ portions 18 are short spanned. A backing sheet 26 is welded onto the lower base surface of the reflective flat ~~[sheets]~~ portions 18 and the tips of the load carrying partition walls 22 within each raised reflective portions 12. Adhesive may be pre applied to the exterior surface of the backing sheet 26 for adhesion to the roadway surface.

Various polymeric materials may be used to form the reflective pavement-marking sheet 10. ~~[This]~~ The polymeric material can be either in a composite form or a single polymer having a high resiliency, good abrasion resistance and ultra violet resistance. Polymer such as polymethyl methacrylate, polybutyle acryl ate, cellulose esters or polycarbonate are among the preferred resins used to form pavement marker 10.

FIG. 3 shows an isometric view of a section for another embodiment, a segment of a reflective pavement marker 10b which is essentially the same as pavement marker 10 having raised reflective portions 12 with only one directional load carrying partition walls ~~[22]~~ 29 that support the reflective faces in the direction of traffic. This type of reflective pavement marker is adequate when low-profiled reflective ~~[faces]~~ portions 12 are preferred.

Reflective pavement marker 10b can be formed using direct embossing method where the cube corner reflective elements 20 are formed on the interior portion of a pre formed transparent sheet, using compression molding process.

Fig. 4 shows a segment of a reflective marker sheet that can be used for pedestrian crossing or barrier marking having multiple of long raised reflective portions 12 facing the traffic direction.

Directional arrows or other signs can be cut from ~~[such]~~ this type of reflective marking sheet, ~~[ing]~~ with variation in cross-sections of present innovative invention.

When a composite material is used to form pavement marker 10, a transparent colorant can be added to the polymeric material forming either the upper or lower portion thereof.

It would be essential that the polymeric components selected for forming reflective pavement marker 10 to be compatible with each other and tenaciously adhere to each other.

The reflective flat portion 18 ~~[spacing]~~ between ~~[the]~~ each two raised reflective portions 12 can be about 1 to 48 inches, depending on the size of the raised portions 12 integrally incorporated within a reflective marking sheet. ~~[ing]~~

FIG. 5 shows a diagrammatic illustration of ~~[the method of]~~ a preferred steps in a continuous production apparatus for the fabrication of reflective pavement marking sheet. ~~[of the type is illustrated in FIG. 5.]~~

The production apparatus includes a rotationally movable carriage means 40 that is generally comprises of a belt structure that includes multiple portions of the cavity side for the compression molding station 53. If needed, heating, pressure, air and cooling elements can be incorporated into the cavity segments 35 within the carriage means 40. A magnified cross sectional segment of typical elements of a compression die 53 is shown in FIG. 6.

Referring now to the fabrication process, transparent sheet line 19 of a polymeric material is fed thru station 50 onto a horizontally positioned region directly above a horizontal segment of the rotationally movable carriage means 40. Carriage means 40 sequentially moves multiple cavity portions 35 toward the compression die station 53.

At the pre-shaping station 51 the sheet line 19 is slowly molded into the cavities of the movable carriage means 40 at the horizontal segment. This pre-shaping station may apply vacuum or just mechanical means or both for pre-forming the desired exterior shape of the reflective pavement marker 10.

The sheet line 19 at station 51 would be in a slack mode, thereby allowing either the mechanical smooth core 51a or the vacuum means within station 51 to shape exterior portion of said reflective pavement marking sheet 10. The mechanical smooth core 51a can be designed to operate sequentially utilizing various sliding means that can be incorporated as part of the core elements (51a), thereby pushing the sheet 19, first by the furthest smooth faced core 51a into the corresponding cavity 35 within carriage 40, then the next core elements thereof. Using thicker sheet 19 can provide an alternative means so that sheet 19 would not splinter during the pre-compression or vacuuming into the cavity shaped position. Heating, pressure, air and cooling means would be available at station 51 for use as needed. Next station 52 is a pressurized resin dispensing system that can be fitted with a metering device, heating timer, manifold and a mixing head for injection of an optically transparent viscous resin. This station 52 can be fitted with a recycling shoot and an override mechanism so that if accidental material dispensing takes place, it can be over ridden manually, thereby utilizing pre mixed patches of resin. An internal release additive may be incorporated into the transparent resinous polymer or an external release agent may be applied to the compression molding dies, or both as needed.

Station 57 is a calendaring roller or skimmer to retain any excess resinous material and divert it into a recycle tank. Station 57 can be supported with vibration devices to eliminate air bubbles that may be entrapped during resin injection process.

Station 53 is the compression molding segment of this continuously forming cycle, which is fitted with the core heads 30, either in a singular core head or multiple core heads as shown in FIG. 5.

A magnified cross section segment of one of the core heads 30 is shown in FIG. 6 together with a segment cross section of a reflective pavement marker 10.

Also shown in FIG. 6 is a cross section segment of the corresponding cavities 35 that would be attached to the rotational carriage means 40.

Station 53 is provided with pressure, heating, cooling, air and water lines to be used as needed. Core head 30 has multiple micro prismatic cube corner reflective element pins together with the cavities for forming the multi directional load carrying partition walls 22. Several methods can be used to fabricate core head 30. One of the preferred methods is to electroform the entire upper part to a thickness of about 0.3 to 0.5 inch or more if needed from metal alloys such as nickel cadmium then a backing or thickening metal will be applied to strengthen the first, upper detailed segment. All cavity moldings for the load carrying partition walls 22 as well as the hexagonal micro cube corner reflective elements 20 would be within this core segment 30.

Proper draft slopes would be incorporated within the wall limits of this core molding to allow uninterrupted release after compression cycle time.

After the compression molded segment 10 is cured, an additional time station or space may be required for cooling interval of the composite sheet formed by bonding of the transparent sheet surface 19 to the cured resinous material defining the cube corner elements 20 and the wall elements 22.

A release agent may be incorporated into the resinous material or externally applied to the core and cavity to allow proper separation of the finished sheet.

Next station 54 is for applying the backup protective sheet 26, which is a thin and compatible plastic, to the base portion of the reflective pavement marker 10.

The backup sheet 26 can be either agglutinated or welded onto either a designated, raised wedge like walls 28, forming rectangular grid like cells within the lower surface of planar reflective sheet 18, or can be directly welded onto the apexes of the multiple cube corner reflective elements 20 within said lower surfaces of planar reflective sheets 18 and the tips of the wedge shaped ends of the load carrying walls 22.

When abrasion resistance surface is needed the continuously rolled transparent sheet 19 can be pre-coated continuously with aluminum trioxide, hard carbon or silicone dioxide utilizing one of various chemical vapor deposition methods or reactive sputtering method.

The substantially continuous transparent sheet 19 can also be made with any desired transparent coloration. The reflective pavement marker sheet can also have only the lower, prismatic cube corner reflective elements impregnated with transparent colorant prior to compression molding the reflective pavement-marking sheet. Both the transparent sheet 19 and the resinous polymer have to be highly stable against ultra violet light.

Station 55 is for pre application of adhesive to the base surface prior to reaching the cutting and storage station 56.

Various thickness of the transparent sheet 19 can be used in this process depending on the size of the protruding reflective portions 12. Commonly used thickness for sheet 19 is about 0.002 to 0.05 inch.

Once the combined composite reflective pavement marking sheet 10 advance from station 55 to the cutting and storage station 56, the rotational direction of the cavity portions 35 within station 40 will allow the release of the finished product toward the cutting region.

Stations 50 thru 55 can be synchronized to functions either simultaneously or sequentially with an override control within every station.

It is clearly understood that this method is applicable to manufacturing one-piece single reflective pavement markers as in U.S. Patent number 6,334,734, Application number 09/634,430, 09/880,780 and 09/982,044 to Attar with minor adjustment and cutting retrofits.

Alternative methods of continuous production of this novel invention can be achieved.

An example of such alternative would include modified stations within a method such as in the previous art of U.S. 3,689,346 to Rowland. This is especially feasible when the desired reflective marking 10 require very low profile, having a reflective portions 12 with a height equal or less than 0.20 inch. While the cavity portion of such embossment can be incorporated as a belt around a drum of various sizes or forms, then a transparent flexible film 19 is applied to the cavity belt. A corresponding pressure drum with the core elements fixed on a belt, mounted onto said drum. This core belt drum must have synchronized reverse motion with respect to the cavity drum.

A designated spacing is to be allowed between the two reverse moving drums, thereby filling the cavities within the embossment molding created between the two drum faces, whereby embossment of the cube corner reflective elements 20 as well as the load carrying partition walls 22 will takes place.

In order to complete this process cycle, an additional station must be added to allow the adhesion of a backing, protective-sheeting 26 onto the lower portion of the continuously formed reflective sheeting 10 to complete such production process.

It is understood that various changes or modifications can be made within the scope of the appended claims for the above-preferred methods for forming the present reflective pavement-marking article without departing from the scope and the spirit of the invention.

The principle processes of this invention are not limited to the particular embodiments described herein. Various embodiments can employ the processes of this invention.

This invention is not limited to the exact methods illustrated and described; alternative methods can be used to form the intended reflective pavement marker of this invention.

Therefore, the invention can be practiced otherwise than as specifically described herein.